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ABSTRACT

This paper describes the activities of a University of California, Davis, advisory group that was charged with monitoring campus classroom environments and proposing corrective action to remedy deficiencies and establish design criteria for consideration in the construction of future instructional facilities. A survey of faculty and students was conducted to determine classroom quality. The areas surveyed were: (1) the classroom's aesthetic quality; (2) features the students and faculty would like to see in their classrooms; and (3) their rating of several classroom design features and attributes they felt were appealing. Next, the problem areas that were revealed are discussed, followed by a review of the immediate actions that were taken to remedy some of the problems. The paper concludes by presenting six recommendations that were made by the group for improving classroom aesthetic quality and for creating classroom diversity. (GLR)

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The Classroom: Physical Environments That Enhance Teaching and Learning (An investigation of the teaching/ learning environment at the University of California, Davis)

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Creating and maintaining a classroom environment that facilitates teaching and learning is so important that we should wonder why we even have to discuss it. It is axiomatic. Halstead (1974), however, in his classic book on state planning in higher education says:

> The design of the physical environment of the learning task is often neglected yet science has established a close correlation between the amount of work people do and where they do it. It stands to reason that a student sitting in an unbearably hot, stuffy room listening to a lecture on cryogenics would not learn as much as he would in a cool, comfortable space. Unfortunately, most college buildings have been planned to impress people from the outside, not necessarily to provide comfort of the users (p. 485).

The Davis campus has been interested in the physical environment of its classrooms and their fitness for teaching and learning. In 1979 the first classroom survey was done. The survey instrument asked faculty and students to evaluate the 110 general assignment classrooms and their suitability for teaching. The results showed that 30 percent of our faculty found classrooms, in general, "ill-suited for their teaching purposes" (Estabrook, 1989, p.5). Ventilation, temperature and aesthetics were indicated as particular problems.

Students rated classrooms higher than faculty did. One third of them, however, found them ill-suited for test-taking purposes (Estabrook, 1989, p. 8). Students also indicated that the rooms lacked storage space for their belongings.

The "problems" uncovered by this study were somewhat remedied over the years by Physical Plant and the Instructional Media Center; however, no on-going, coordinated, monitoring function other than Physical Plant's twice yearly inspection for broken furniture, blinds, missing chairs, etc., and painting when needed, was established. The Registrar's Office was considered the "owner" of general assignment classrooms but had no budget to improve them. If something was wrong in a classroom, a faculty member might call the Office of the Registrar to complain. The Office then contacted Physical Plant to fix the problem. Numerous times Physical Plant would say they had no money in the budget to make a repair. If it was to be done, the Registrar's Office would have to pay for it. So it didn't get done!

The lack of coordination was addressed in the Fall of 1988 when UCD's new chancellor established an Instructional Facilities Work Group (Davis is famous for its well developed committee structure). The Executive Vice Chancellor, the Associate Vice Chancellor for Academic Affairs, the Associate Vice Chancellor for Planning and Budget, and the Assistant Vice Chancellor for

Facilities formed the workgroup. It was decided that the workgroup needed some way of establishing the quality of our classroom environment. There were lots of anecdotal stories and grumbles about the poor conditions of our classrooms but nothing definitive except our that classrooms were overcrowded.

The "some way" was the establishment of another committee, the Instructional Space Advisory Group. The members of the group consist of representatives from the Teaching Resources Center, whose representative chairs the group and conducted the 1979 classroom study, the Registrar, Architects and Engineers, Academic Senate Committee on Academic Planning and Budget Review, Instructional Media Center, Office of Planning and Budget, Academic Senate Committee on Teaching, an at large member of the faculty, Physical Plant, and both an undergraduate and a graduate student. An impressive group of people!

Our appointment letter from the Chancellor stated:

> The group is being established to monitor, on an ongoing basis, the conditions of classroom and other instructional facilities. It would propose corrective action to remedy deficiencies and establish design criteria for consideration in the construction of future instructional facilities.

The Chancellor further said:

> I see the work of the Instructional Space Advisory Group as critically important in addressing concerns that are central to the instructional mission of the University.

We began meeting in December, 1988. Since we had no real data on the state of our classrooms, we decided that the most appropriate form of action would be to once again survey faculty and students regarding classroom quality. Were our classrooms good places in which to teach and learn?

A survey instrument was designed by the Advisory Group that was much more comprehensive than the 1979 survey. The survey

> consisted of twenty items to be rated on a 5 point scale ranging from excellent to very poor, five items asking faculty to indicate what features (furniture, equipment, etc.) they need or prefer to have, and one item asking the faculty to identify the factors that contribute to lack of cleanliness. Furthermore, faculty were also asked to comment and offer suggestions for improving classrooms (Estabrook, 1989, p. 1).

The survey was sent to the 1600 members of the Academic

Senate and 300 lecturers. They were asked to complete a form for every room in which they taught during the Winter 1989 quarter. We received responses from some 400 faculty members. This represents between 30 and 40 percent of the faculty actually teaching that Winter quarter. The 400 responses resulted in 308 useable ratings of 101 of the total 109 general assignment classrooms and 170 non-general assignment classrooms. I am only discussing the information gathered on the 101 general assignment classrooms. The Advisory Group hopes to review non-general assignment classrooms in the future.

The responses showed that 55 percent of the faculty evaluated their classrooms as good to excellent teaching environments and only 16 percent evaluated them as poor to very poor teaching environments, an improvement over the 1979 survey results. The average rating of all classrooms as a teaching environment was 3.45. In 1979, the average rating was 3.1 (Estabrook, 1989, p. 4).

The survey did identify four major problem areas. A problem area was defined as 25 percent or more of the faculty rating the feature as poor or very poor. Two of the identified problem areas were the same as those identified in 1979--aesthetics, and temperature and ventilation.

The aesthetic quality of our classrooms was identified as the number one problem area. The overall average aesthetic rating of general assignment classrooms was 2.66. Of the classrooms that received an aesthetic rating, 29 rooms (29 percent) received average ratings of 2 or less and 75 percent of the rooms received evaluations of 3 and less. Rooms were described as ugly, stark, cold, grim, spiritless, windowless, and colorless. Compared to the 1979 findings, there was a ten percent increase in the number of rooms rated as lacking aesthetic value. Halstead (1974) discusses the importance of aesthetics in the teaching/learning process when he says:

> To a greater extent than perhaps any other type of institution, colleges and universities need to create environments suitable to living and working. The largely indoor pursuit of teaching and learning requires that the character of instructional space--its shape, climate, lighting, color, acoustics, and seating--be conducive to the highest level of communication and mental productivity (p. 501).

Styne (1990), addressing the needs of office workers said, "People are greatly influenced by the visual aspects of their environment. . . . People are able to perform best when they are visually comfortable" (p. 78). The data from the survey strongly indicate that our faculty and students are not visually

comfortable in their classroom environments and this can lead one to conclude that they are not performing at their best.

Dimming and blackout capabilities were also identified as problems. Faculty were particularly frustrated because they could not dim rooms leaving sufficient light for students to take notes and at the same time have the room dark enough for students to see the screen projections. Poor lighting conditions in general were commented upon throughout the survey responses.

Forty-four rooms (55 percent of the 80 rooms rated) received average ratings of 3 or less for dimming capabilities and 32 rooms (46 percent of the 70 rooms rated) received average ratings of 3 or less for blackout capabilities. We have many internal classrooms and they have no blackout problem. This fact may help explain why only 70 rooms were rated for blackout capabilities.

Temperature and ventilation were identified as problems in numerous rooms. One of our main classroom buildings has a noise problem caused by the ventilation system. Faculty members with hearing aids have particular difficulty because hearing aids amplify sound. Faculty teaching foreign languages have also complained. The noise prevents students from hearing fine sound differences in other languages. The administration has already received a petition from 15 instructors of oriental languages requesting something be done about the problem. The heating and ventilation system of this building is scheduled for repair in Summer, 1992.

Faculty were particularly critical of poor ventilation. In many cases they could not open windows or did not have windows to open. If they opened classroom doors, noise from the outside created distraction.

Of the 98 rooms rated for temperature and ventilation, 41 (42 percent) received ratings of 3 and below and 19 (19 percent) received ratings of 2 and below. This situation is far from ideal. Halstead (1974) writes:

> It is generally recognized that high temperature and humidity produce physiological and psychological stress that accelerate fatigue, causes people to work more slowly, exert greater effort, and make more mistakes. The classroom climate in particular should be carefully controlled not only to provide physical comfort but also to serve as a positive factor in the learning process by engendering alertness and attention. To maintain such a climate, the air must be treated to simultaneously controlled temperature, humidity, cleanliness and circulation (p. 503).

Cleanliness or the lack thereof was the other major problem

identified by faculty. There were two questions on cleanliness. One question dealt with overall cleanliness of the room and the other with the cleanliness of chalkboards. Faculty were mainly concerned with chalkboards. They commented on dirty chalkboards, chalk dust, dust-saturated erasers and the lack of chalk. Faculty also complained about the number of announcements marked "Do Not Erase" left on chalkboards. Evidently faculty do not erase them!

In terms of overall room cleanliness, in addition to chalk dust, faculty were concerned with newspapers. Inserts to the student daily newspaper were identified as the major problem. Lack of trash cans and lack of maintenance during the day were considered problems by over 30 percent of the faculty respondents.

Of the 99 rooms rated on general cleanliness, 50 rooms (50.5 percent) received average ratings of 3 or less. Of the 98 rooms rated on chalkboard cleanliness, 40 rooms (41 percent) received average ratings of 3 or less but only 8 rooms (8 percent) received average ratings of 2 or less.

The faculty were also asked to identify features they require or would like to have in a classroom. The Advisory Group was particularly interested in these responses because of its advisory role in future classroom design.

It is interesting to note that 70 percent of the faculty respondents to the question about desired type of chalkboard wanted the "traditional" blackboard. The white, magic marker board does not appear to be acceptable in a general assignment classroom, at least as far as the UC Davis faculty is concerned.

In terms of equipment, 60 percent of the faculty use or would use slide projectors and/or overhead projectors. Approximately 40 percent indicated they would use VCR players and TV monitors and 20 percent indicated they would use 16mm film projectors and large screen video projectors for computer images.

The survey also solicited information about the type of furniture faculty would like added to classrooms. No more than two faculty asked for the same thing, i.e., pointer, stool rather than chair for faculty to sit on, clock (UC Davis does not put clocks in classrooms because they have the habit of disappearing all too frequently), hook for hanging instructor coat, etc. Some wanted things removed, particularly student chairs. Crowding in classrooms will come up later when I discuss student responses to the state of our classrooms.

Faculty were also asked to respond to the type of student seating arrangements they prefer in classrooms. The responses indicate that about half of the faculty want fixed, auditorium-

style seating and the other half want movable seating. Presently 18 percent of UCD's classrooms are auditorium style, and ten percent are seminar style, which is exactly the percentage of faculty who indicated they wanted seminar-style rooms. Some ten percent of the faculty would like the continuous desk seating common in professional schools.

The student evaluation of general assignment classrooms was conducted in the Spring, 1989 quarter. Two classes, one morning and one afternoon, were selected for each of the 109 general assignment classrooms. Faculty were asked to distribute the survey in class and to return the completed surveys to the Advisory Group. The Advisory Group received 3,998 student survey responses. This is estimated as almost a 100 percent response rate since the surveys were completed and collected in class.

Students were asked to evaluate many of the same things about the general assignment classrooms that faulty evaluated. They had many of the same complaints as faculty, but their number one complaint was about crowding in the classroom. They were particularly critical of the space between seats, column and row. Thirty seven (37) percent rated seating as poor to very poor. Commenting on our lecture halls, students said their knees touch the seat in front and their arms touch the next person. The crowding phenomenon has become more evident over the last several years as UC Davis' enrollment has increased dramatically with no increase in the number of classrooms. Most classes are at maximum capacity or above.

The size of writing surfaces was rated poor to very poor by 28 percent of the students and 34 percent rated storage space for personal belongings as poor to very poor. Twenty seven (27) percent rated the suitability of a room for test taking as poor to very poor.

Students also criticized temperature and ventilation systems. Rooms are too cold or too hot and the noise from the ventilation systems make concentration and hearing difficult. Halstead (1974) writes:

> "A student in the classroom is properly seated if he has a clear view of the instructor, is provided with suitable writing surface and a place for book storage, is reasonably comfortable, and is so situated that persons going to and from adjacent seats will not disturb him" (pp.506-507).

Many of UC Davis' classrooms seem to have conditions opposite to those Halstead recommends.

A number of students complained that there were not enough left-handed desks available. Standard classroom set up specifies

that each room have ten percent left-handed desks. The Advisory Group is not sure if we have more left handed students, at least more than the ten percent population average, or if, due to our crowded conditions, right-handed students are using left-handed desks because that was all that was available when they came into the room.

Students were also concerned with the lack of classroom aesthetics. Some of the comments were: "this room is kind of ugly and uninspiring for learning," "room is ugly and windows don't open," "colors clash." "this room is typical instructional blah," "a brighter, more lively colored room would be more conducive to learning," and "this classroom, like most others, is lousy."

The Advisory Group took a few immediate actions to remedy some of the problems. The Physical Plant representative directed custodial staff to clean the blackboards, chalk trays, and erasers on a nightly basis and he arranged for an additional trash can in each general assignment classroom. Some of the classroom problems identified in the surveys were known to Physical Plant and were on their maintenance or improvement list. Dimmers and blackout blinds were scheduled to be installed in a number of rooms. Lighting was scheduled for improvement in one of the small auditoriums. As indicated before, the heating and ventilation system in one of our main classroom buildings was already scheduled for repair in 1992. For the 1989-90 fiscal year Physical Plant committed $280,000 for specific classroom projects. This is really not a large sum of money when you consider UC Davis' overall budget.

The Advisory Group did have the opportunity to experiment with new student chairs. Physical Plant was about to order replacement chairs and asked the the Advisory Group to look at several chairs. The Advisory Groups selected a chair that had a larger writing surface, a slightly wider seat and a storage basket underneath.

The chairs were placed in two heavily used classrooms shortly after the beginning of the Fall, 1990 quarter. A short survey was distributed to students in four classes, two in each room, at the end of the quarter. The response to the chairs was overwhelmingly positive except for the storage area. The students were not using it for storage. They said it was too small, too inconvenient, and they would forget items they stored, but said it made a great foot rest!

The Advisory Group was most concerned about the low rating of the aesthetic quality of our classrooms. As noted earlier, visual comfort aids performance. It was decided to do a second survey specifically addressing the aesthetic quality of our classrooms.

The graduate student representative on the Advisory Group was a Ph.D. candidate in environmental/developmental psychology. Her research emphasis was in aesthetic preferences emphasizing the psychological need for natural qualities in built settings. She suggested that the survey establish what in particular is aesthetically unpleasing about our rooms and what do faculty and students perceive as the ideal classroom? She suggested a fellow Ph.D. candidate in social psychology/group dynamics with interests in human group activity in isolated environments and human interactions with technology as one who might be interested in doing a study with her.

The Advisory Group agreed and requested the two students to submit a proposal with budget. The Advisory Group accepted the proposal and requested funding for the study. The Instructional Facilities Work Group approved the project and provided the funding. The aesthetic study was conducted in the Spring, 1990 quarter.

Nine classrooms were selected "based on a range of sizes, locations on campus, subjects being taught and on a range of aesthetic ratings obtained from the 1989 Campus Classroom Survey . . ." (Caldwell and Hoyt, 1990, p. 3). One morning class and one afternoon class were selected for each of the nine rooms. Students were surveyed in class. Faculty received their survey through the mail. Responses were received from 43 faculty members and 890 students. Of the nine classrooms, eight received enough responses to be included in the data analysis.

The first section of the survey asked faculty and students to differentiate between the current classroom and the ideal classroom on thirteen experiential criteria. The results indicated that:

> respondents strongly desire classrooms to be bright, spacious, large, natural, organized, and harmonious. They like the rooms to be (in order of preference) comfortable, airy, functional, inviting, happy, interesting and beautiful (Caldwell and Hoyt, 1990, p.3).

The ideal classroom is rather different from the one the respondents perceive they are in. They "indicated that their current classroom is dull, confining, synthetic and cluttered" (Caldwell and Hoyt, 1990, p.3).

The second section of the survey asked faculty and students to rate several design features or attributes of the room they were in. Design features in order from most disliked were wall color, chair design, floors, chair color and lighting. Many respondents made comments similar to those made in the general classroom surveys. They said spacing between chairs was

inadequate, leaving little leg room and making it almost impossible to move between rows; ventilation was poor; rooms lacked windows; chairs were uncomfortable; and desks were too small. In general, the rooms in this survey were described as needing improved comfort.

The third section of the survey asked respondents to rate design features to improve the classroom environment and then rank priorities for improvement. Wall color, adding plants, lighting type, lighting level and new chair design were selected by respondents as the items they preferred changed. In priority order respondents selected wall color, lighting, chair style and plants. Student and faculty artwork, and flooring were medium priorities and wallpaper, wood paneling and podium style were low priority changes.

Comments by students and faculty regarding preference for classroom improvements were punctuated by concerns of cost. In particular, adding art work to classrooms brought forth concerns about cost. In addition, a number of faculty and students suggested that artwork might be too distracting.

Adding plants to classrooms was a high preference of respondents. Maintenance of plants, however, might be a problem although there are numerous houseplants that require minimal maintenance and light.

Wall color was the most disliked of any design feature. When asked to select preferred wall colors respondents chose white, then pale blue, and pale yellow or pale green as last preferences. Softer wall colors are in, and orange, brown and red wall colors are out.

A regression analysis of the data in this survey was performed relating the aesthetic ratings received by these eight rooms in the earlier classroom study. "The best prediction of the aesthetic ratings of these rooms came from difference between ideal and real values of the experiential components of naturalness, spaciousness, and organization"(Caldwell and Hoyt, 1990, pp.5-6).

Another regression analysis "related ratings of chair design and the experience of happiness" (Caldwell and Hoyt, 1990, p. 6) to the overall aesthetic ratings of the rooms.

In summary, the researchers concluded that there are:

> two problems with classroom design that influence aesthetic preference and ultimately instructional function. The first problem is that current classroom design features do not support the experiential needs of the users. Students and faculty desire rooms

> to be bright, spacious, large, natural, organized, harmonious, comfortable, airy, functional, inviting, happy, interesting and beautiful. Many of the surveyed classrooms do not support these needs.
>
> The second quality in current classroom design that does not support aesthetic appreciation or instructional tasks is the larger problem of crowding. . . . the majority of respondents indicated that the ideal classroom should be "spacious," "large," "comfortable," and "airy" (pp. 10-11).

These terms are basically the opposite of crowding and it is obvious from student and faculty comments that they do not like the crowded conditions they face daily in the classroom. Chairs, besides being too close together, were also uncomfortable and were one of the highest priorities for change. "Chair design and space between chairs was found to be a significant predictor of [higher] aesthetic ratings for a room" (Caldwell and Hoyt, p.11).

Caldwell and Hoyt further state:

> that crowding and decreased comfort <u>significantly</u> and <u>consistently</u> decrease aesthetic ratings of a room. . . . crowding influences emotions which strongly influence the tasks and purpose of the classroom. It is through good design that we can support the instructional functions of the classroom.

They also suggest that occupational safety guidelines and measurements of a range of potential users specifications should be applied to classrooms. These guidelines allow for greater distance between chairs. Not only would there be a less crowded classroom environment but the additional space would "reduce the incidence of casual cheating, as adjacent students' work would be outside of the natural field of vision" (Hoyt and Caldwell, p. 11).

The Instructional Space Advisory Group spent much time discussing the results of this study. Members had their own suggestions for improving the aesthetic quality of our classrooms and for creating diversity among classrooms. We did not want "sameness" to run through our buildings and classrooms since "sameness" if often equated with being boring or dull. Differences help one orient oneself in a building and also make it easier to communicate about a room to others. The Advisory Group made the following recommendations to the Work Group:

1. that all classroom walls be painted in shades of off-white and that color be supplied by the following classroom features: student chairs, bulletin boards,

trim, blinds, instructor's table and chair, lectern, projector stands, and chair rails.

2. that student chairs be of the same color in a given room. In the case of movable chairs, this could be accomplished by having student chairs be of the same color by building, floor, or wing. In the case of fixed seating, we recommend that the chair colors be distinct for each lecture hall in any given classroom building.

3. that classrooms have chair rails along the walls and for several reasons: functional--they protect the wall and thus reduce maintenance costs; aesthetic--they can be a source of color or if made of wood, they can contribute to the room having a "natural" quality; perceptual--they provide an horizon and reduce the sense of being in a box with blank walls.

4. that lighting levels in classrooms be raised and that the standards for minimum lighting levels be revised to reflect the new minimum lighting level. Students find the current lighting level too low.

5. that light type be selected on the basis of its aesthetic as well as its functional properties. Since the aesthetics of the room is affected by the hardware (i.e., type of fixtures) as well as by the lighting effects created when the room is brightly or dimly lit, we recommend that both aspects be considered when selecting the appropriate lighting type. . . . [and]

6. [that we] use . . . graphics in classrooms but suggest that art work and plants be introduced on a pilot basis only so that we can adequately assess their role in the educational environment. Since we consider graphics to be only one element in the total design, we are not suggesting that all classrooms should contain graphics but only those in which it is appropriate (Estabrook, 1990 pp. 2-3).

The Advisory Group also recommended that a professional interior designer be hired to develop model designs for two classrooms identified for remodeling based on the study findings and to develop a color palette for use throughout our buildings. The color palette would be used by Physical Plant as they repaint classrooms. We have been funded to hire an interior design consultant. It also appears that we are being funded to remodel two classrooms.

The Advisory Group also began developing guidelines for state of the art media classrooms. The media identified by faculty as necessary in a classroom are to be included in the model classroom project. In addition, we are in the design state of a new Social Sciences and Humanities building that will have a 400-seat lecture hall. The Advisory Group will provide state-of-the-art media guidelines for that lecture hall.

We have been a busy group of people but we are making a great deal of progress in accessing and improving the physical environments of our classrooms, which should enhance the teaching and learning that goes on in them rather than detract from it. It will take years and money to do, but we now have administrative support and a structure in which to do it.